TESTIMONY BEFORE THE UNITED STATES SENATE

COMMITTEE ON FINANCE

APRIL 19, 2007

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Thank you, Chairman Baucus for the invitation to testify before this committee.

The age of petroleum is ending. Even if we could afford to pay a billion dollars a day indefinitely to import oil, we cannot afford the danger our petroleum addiction poses to our economic and national security. We do not have an "energy" problem as we mistakenly thought in the 1970s. Our problem is that modern society is almost completely dependent on petroleum for the liquid transportation fuels we need to move people and products around. Our dependence on petroleum for mobility puts us at great risk geopolitically, environmentally and economically. We have very few petroleum alternatives that can simultaneously provide geopolitical, environmental and economic benefits. Biofuels are one of this handful of alternatives.

I have spent over thirty years thinking about and working to develop biofuels, particularly cellulosic ethanol. From that background, I will briefly summarize the status of biofuels: where we are today, what we can expect in the next 5 years or so, and the long term contribution biofuels can make to our liquid fuel needs. I will also comment briefly on the role farmers could play in the biofuels future.

<u>Biofuels today</u> Biofuels today means ethanol and biodiesel. Ethanol comes from sugar, whether that sugar is derived from cane sugar, as in Brazil, or from starch in corn grain, as in the United States. We produce our biodiesel from soy oil. Because of price and volume considerations, biodiesel from soy oil will never be more than a niche fuel. Corn ethanol will grow rapidly until it reaches a limit of perhaps 18 billion gallons of ethanol per year, roughly 10% of our gasoline consumption. This is an important contribution, but it does not fundamentally change our dependence on petroleum. To end our petroleum addiction, we must produce ethanol from cellulosic materials. These are inexpensive, abundant residues including crop, forest and urban wastes as well as crops and woody plants grown specifically for their energy content. We could produce cellulosic ethanol today using well-established technology

for about $2.50 per gallon. Unfortunately, that's just not good enough yet to compete with petroleum.

Biofuels in five years But I have good news. Over the past thirty years or so a relatively small, but determined group of people have worked to develop improved technologies for cellulosic ethanol. I am proud to be among that group. Recently the Department of Energy announced financial incentives for a truly historic project…establishing six large demonstration plants for cellulosic ethanol using these improved technologies. One of Mr. Khosla's companies is testing a seventh approach with financial assistance from the State of New York. So we are testing seven approaches simultaneously. I know many of these technologies in considerable detail. In fact, one of my inventions will be tested at a cellulosic ethanol plant in Iowa. In five years or less I believe we will have good evidence that some of these technologies can produce cellulosic ethanol for around $1.20 per gallon.

When that happens, the next step will be to establish full scale commercial plants based on the most successful new technologies. Because these technologies are new there will inevitably be bugs in the system that can only be worked out in large commercial scale plants. Also, some cost improvements will only be achieved when suppliers have big markets, for example, for their enzymes which convert cellulose to sugars.

So there will still be very large business risks. Congress should consider providing tax credits or other incentives for the first full commercial scale plants in order to reduce these risks, and so investors will not fear that their investments will be stranded. Such an approach could be limited to the first billion gallons of cellulosic ethanol. Cellulosic ethanol will happen—but such incentives can help reduce our dependence on foreign oil much more quickly.

When those large scale commercial plants become fully functional, the economics become well understood and the risks are sufficiently reduced, I believe cellulosic ethanol will take off. The industry will grow very rapidly, limited mostly by our ability to gather enough cellulosic raw material together in one spot.

Biofuels in the longer term What can we expect in the longer term? I testified before Senator Lugar's Committee on Agriculture in 2001. I will repeat now what I said then. I believe that in the longer term we can replace all of our petroleum imports, every bit of it, with cellulosic ethanol produced domestically at much less than $1.00 per gallon. This is not a pipe dream, but a sober, hardheaded assessment of our ability to produce the required raw materials and process them to biofuels.

Biofuels and farmers As ethanol production technology improves, the cost of processing will become less and less important, while the delivered cost of

the cellulosic biomass will become more and more important. In other words, the farm sector will only grow in its relative importance. Herein lies both danger and a great opportunity.

How can we be sure that our nation's farmers and farm communities benefit from cellulosic ethanol? If they are simply suppliers of raw materials to others who process the raw materials to fuels, farmers probably will not do very well. We need research, policies, technologies, supply chains and business models that help farmers: 1) supply low cost cellulosic biomass and 2) participate financially in the processing, thereby capturing some of the added value. Our research, energy, agricultural, environmental and tax policies will need to be properly coordinated to accomplish this…a tall order. Regarding tax policy, which falls under your jurisdiction, we need incentives to encourage the collection of cellulosic materials, the planting of relevant crops and the development of the first commercial scale cellulosic ethanol plants. These steps will maximize our country's ability to produce this alternative fuel.

But if we do that, we can realistically expect a new era for our country and for rural America, an era in which our petroleum addiction is beaten, in which we are much more secure geopolitically and environmentally, and where prosperity has returned to our rural communities. That is a future worth not only contemplating, but achieving.

Thank you, Mr. Chairman, I look forward to your questions.